

**Amendments to the Drawings**

Fig. 5 has been amended to remove reference numeral "330."

**ATTACHMENT:** One Replacement Sheet containing amended Fig. 5

## REMARKS

The applicant's undersigned counsel thanks Examiner Pettitt for his very careful and thorough examination of the present application. The undersigned also appreciates the Examiner's indication of allowable subject matter in claims 26-29, 35-36, 38, 50 and 52-53.

Herein, claim 1 has been amended to specify that no cold heat exchanger of the orifice pulse tube refrigerator penetrates the hydrogen storage vessel. Basis for this amendment can be found, e.g., in Fig. 1 as-filed. Claim 2 has been rewritten in independent form with no change in claim scope. Claims 14, 34-35 and 49 have been amended to correct informalities. No new matter has been entered.

In the Office action, the Examiner acknowledged applicant's election of claims 1-48 and 50-53 in response to a prior Restriction Requirement, and has indicated that claim 49 is withdrawn from consideration.<sup>1</sup> However, the prior Restriction Requirement, Office action dated August 2, 2006, required restriction between Group I (**claim 45**) and Group II (claims 1-44 and 46-53). In response, applicant elected Group II (claims 1-44 and 46-53), and further amended claim 45 to depend from claim 1. Accordingly, it is believed the Examiner intended to indicate claim 45 is withdrawn, and not claim 49. Claim 49 should not be withdrawn, because it depends from (and therefore incorporates) an earlier claim that has been examined on the merits. In any event, because claim 45 now depends from (and incorporates all the limitations of) claim 1, it is respectfully submitted that all claims, 1-53 inclusive, are properly examined in this case based on the Applicant's previous election of Group II.

The drawings have been objected-to based on a formality. The undersigned appreciates the Examiner having pointed out the error, and Fig. 5 has been amended herein to overcome the objection.

Claims 14, 34-35, 37, 38, 43 and 49-50 have been objected-to based on various informalities. Claims 14 and 34-35 have been amended to overcome the objections. The objections to claims 37, 38, 43 and 49-50 are respectfully traversed. These objections relate to the use of commas. In these claims, commas are used to delimit the elements of list, except they are not used after the last element that precedes "and" in a list. It is respectfully submitted that

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<sup>1</sup> Claim 49 has been identified as "withdrawn" in the Listing of Claims based on the Examiner's indication to that effect, although that indication is believed to be in error for the reasons given in this paragraph.

this is proper grammar, and accordingly that no additional commas are needed. Applicant has amended claim 49 to remove an extraneous “and.”

Claim 1 has been rejected under 35 USC § 102(e) as being anticipated by Royal et al. (hereinafter “Royal”). Claim 1 has been amended to specify that “no cold heat exchanger of said orifice pulse tube refrigerator penetrates the liquid hydrogen storage vessel” Conversely, in Royal, the cold heat exchanger 13 penetrates the storage vessel (vessel shell 1). See, e.g., col. 4 lines 1-37, describing the embodiments in Figs. 1-3. Accordingly, claim 1 patently distinguishes Royal, and the rejection thereover is believed to be overcome.

Claims 1, 2 and 46 have each been rejected under 35 USC § 103(a) as being allegedly obvious over a reference entitled “Garnier, D. (Innovative Confinement Concepts, Berkeley California, February 24, 2000 – ICC-2000)” (hereinafter “Garnier”) in view of Wang et al. Initially, it has not been established that Garnier is a proper reference under any subsection of 35 USC § 102. For example, it is not evident that Garnier is a printed publication within the meaning of 35 USC § 102(b). Nor is the date printed on the front page verifiable just by looking at the document, as would be a publication date for a paper published in a recognized trade publication or journal. Moreover, Garnier is summary in nature, and consists of headings and bullet points that do not convey complete teachings to persons of ordinary skill in the art regarding the contemplated “LDX Project,” and apparatus. Therefore, much information must be assumed or inferred because it is not clear from the reference. Accordingly, it is respectfully submitted that all the obviousness rejections based on Garnier should be withdrawn for these reasons alone.

But assuming Garnier to be a proper reference, the rejections of claims 1, 2 and 46 are further traversed on the merits. Each of these claims is addressed below.

Claim 1: The Examiner’s position is that Garnier teaches a storage vessel that can hold liquid hydrogen, and a cooling system adapted to counteract heat transfer into that vessel. Office action, p. 6. The Examiner acknowledges Garnier does not disclose an OPTR, but argues it would have been obvious to combine Garnier with Wang, which discloses an OPTR. Initially, it is not evident that the vessel in Garnier is designed to hold liquid hydrogen, nor that liquid hydrogen would work in Garnier’s device. It is believed that the liquid helium in Garnier is used to cool a superconducting coil so that it will be able to levitate. The undersigned does not know that liquid hydrogen is suitable for this application; for example, it is known that liquid helium is

much colder than liquid hydrogen (boiling point of the former is about 4 K, and of the latter is about 20 K). So it is not even evident that liquid hydrogen would function in Garnier's device. Nor does Garnier provide enough information to know; i.e. no operating temperatures are disclosed.

Moreover, there is absolutely no motivation to use an orifice pulse tube refrigerator from Wang in Garnier's device. It is believed that the toroidal vessel in Garnier is intended to float within the greater vacuum chamber indicated by the Examiner at page 8 of Garnier. See, e.g., the illustration on page 8 of Garnier, and related text on the same page that describes "a high performance super conducting floating coil." See also p. 7, describing one of the "LDX's Experimental Goals" to be as follows: "Demonstrate reliable levitation of a persistent superconducting ring using distant control coils." The liquid helium within the toroidal vessel is believed to be used to supercool a coil wrapped therearound so that it will float in a field that is generated in the larger vacuum vessel by the above-noted "control coils." It would not be practical to couple an orifice pulse tube refrigeration system with a floating toroidal apparatus. It certainly is not evident from either Garnier or Wang how this could be done. In Garnier, at page 10, the helium vessel is shown wrapped in a radiation shield and a vacuum shell. These are both passive insulation structures that shield against heat leak into the interiorly-located helium vessel, but do not require any rigid or tethered connections to any external structure, such as an active refrigerator. It is respectfully submitted that to couple an OPTR to the helium vessel in Garnier would render that vessel inoperative for its intended purpose, namely to float within the larger vacuum chamber based on superconductive effects. Rigid or tethered connections attached to the toroidal structure in Garnier would prevent, or at least inhibit, the toroidal structure from floating freely, thus disrupting Garnier's contemplated experiment. This is believed to be the reason that only passive insulation media (vacuum shell and radiation shield – see page 10) are used in Garnier, because they require no external connections that may interfere with levitation of the toroidal structure. For these reasons, the combination proposed by the Examiner would render Garnier's apparatus inoperative for its intended purpose, and thus cannot be considered obvious. Accordingly, the rejection of claim 1 based on this combination is believed to be overcome on the merits.

Claim 2: This claim has been rewritten in independent form with no change in scope. Claim 2 specifically requires the liquid hydrogen storage vessel to be in the shape of a hollow

toroid, in addition to the other features originally recited in claim 1. Again, Garnier is relied upon in the Office action to teach a toroidal liquid hydrogen storage vessel, and Wang is relied on to teach an OPTR. However, these references cannot be combined to support the rejection for at least the same reasons given with respect to claim 1 above. Accordingly, the rejection of claim 2 is also believed to be overcome.

Claim 46: This claim recites a toroidal storage vessel in combination with an orifice pulse tube refrigerator, similarly as claim 2. Accordingly, the rejection of claim 46 is believed overcome for the same reasons as for claims 1 and 2 above. In addition, claim 46 also recites that the OPTR extends within the void space at the geometric center of the toroidal storage vessel. Neither Garnier nor Wang discloses this feature. The Examiner has argued it would have been obvious to arrange the OPTR and storage vessel this way “for the purpose of providing a compact refrigeration system for refrigerating hydrogen at a low temperature to prevent hydrogen from evaporating.” Office action, p. 12. But the stated motivation, to provide a “compact refrigeration system,” cannot be found anywhere in the references, and instead is only evident after viewing applicant’s disclosure. For example, looking at Garnier and considering the relative size of the vacuum chamber surrounding the toroidal vessel in that reference, compactness or space constraints do not appear to be of any significant concern. For this additional reason, the rejection of claim 46 is believed to be overcome.

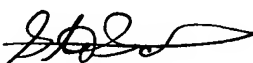
In view of the foregoing arguments, it is respectfully submitted that claims 1, 2 and 46 are now in condition for allowance. All remaining claims are dependent claims, and are therefore believed to be allowable by virtue of their dependence on an allowable base claim. Accordingly, all claims are now believed in condition for allowance, and early notice to that effect is respectfully requested.

Should the Examiner have any questions or concerns with respect to the instant submission, or for any other reason to advance the prosecution hereof, he is invited and requested to **please contact the undersigned attorney** at the phone number printed below.

If there are any fees required by this communication that are not covered by an enclosed check, please charge any such fees to our Deposit Account 16-0820, Order No. 35494US1.

Respectfully submitted,

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